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PATENT SPECIFICATION

DRAWINGS ATTACHED

824,783

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International Classification:—F02b. F04d. F06d.

COMPLETE SPECIFICATION

Improvements in or relating to Cooling Systems

We, FORD MOTOR COMPANY LIMITED, of 88, Regent Street, London, W.1, a company incorporated under the laws of Great Britain, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to cooling systems, more particularly for automobile engines.

In the past automobile engines have been cooled by circulating a coolant such as water alone or in combination with certain anti-rusting and/or anti-freezing compounds, and by having the engine turn a cooling fan which caused air to circulate rapidly about the engine. It takes a considerable amount of power to drive the engine fan and also the fan causes certain undesirable noises. Since the fan is needed only at certain temperatures the horsepower saving and noise elimination could be accomplished if the fan could be automatically turned off when it is not needed and turned back on when it is needed.

The invention consists in a cooling system wherein a liquid is circulated by means of a coolant pump comprising a device to associate the impeller of said pump with a fan drive member in a drive chamber so that upon introduction of liquid into said drive chamber said fan will be driven by said pump impeller and upon release of said liquid from said chamber said fan will be disengaged from said impeller, temperature-controlled means to introduce liquid from the system into said drive chamber at a given engine temperature, said means being adapted to release liquid from said chamber at a given temperature, and gas supply means to fill and empty said drive chamber with a gas as the drive chamber is respectively emptied and filled with said liquid.

The invention further consists in an automobile cooling system wherein there are passages in the automobile engine for coolant to flow, where there is a coolant pump, a radiator, a radiator pipe connecting said engine passages and radiator, a radiator by-pass connecting said passages and said coolant pump, a radiator thermostat which at a predetermined temperature will close the pipe between said radiator and engine and direct coolant from said engine passages through the coolant pump back to the engine passages, comprising a driven member, an impeller, said impeller being driven by said engine, a chamber containing said member and impeller, means for connecting said member with an engine fan designed to circulate air about said engine, said member being coaxial with and axially spaced from said impeller, the facing surfaces of said impeller and said member being designed so that upon introduction of fluid between said surfaces rotational force will be transmitted from said impeller face to said member face, a venturi, said venturi being located in said radiator by-pass, an aspirator tube, said tube connecting said venturi and said chamber, a by-pass thermostat, said thermostat being located between said venturi and said coolant pump, a chamber outlet pipe, said outlet pipe connecting said chamber with an upper portion of said radiator above the water level in said radiator.

In the accompanying drawings:—

Figure 1 is a schematic view of an automobile cooling system;

Figure 2 is a cross section taken at 2—2 of Figure 1;

Figure 3 is a schematic view of an additional embodiment of this invention;

Figure 4 is a cross section taken at 4—4 of Figure 3;

Figure 5 is a cross section taken at 5—5 of Figure 3;

Figure 6 is a schematic view of an additional embodiment of this invention;

Figure 7 is a cross section taken at 7—7 of Figure 6.

There is much public interest to-day to increase the horsepower of automobile engines

yet to maintain the engine at its present size and to increase the engine economy. The automobile engine fan requires up to 34 horsepower to drive it. The above horsepower increase can be saved and economy can be achieved if the fan is not used when it is not necessary. It is also desirable to increase acceleration in to-day's automobiles. By this invention, through provision of a hydraulic coupling to drive the engine fan, power devoted to turning the fan lags the increase in engine revolution frequency. It therefore allows more power to engine and automobile acceleration even when the fan is fluidly engaged.

In Figure 1 is shown a schematic view of an embodiment of this invention with the parts of the cooling system placed in a way so that operation of the system will be more apparent, although the location of these parts will not necessarily be the same. In fact, in an actual automobile engine the relative positions are not the same but the principle of operation is similar. In Figure 1 is seen a front view of a water pump 21, a side view of a radiator 22, a diagrammatic view of venturi tube 25, thermostat 26, engine thermostat 27 and connecting means between the various elements. In Figure 2 which is a cross section at 2—2 of Figure 1 through the water pump is seen a fan 23 fixed to support 30 which is fitted on the fan drive shaft 31. Shaft 31 in turn is press fitted to turbine 32 which is turned by impeller 33 when there is liquid in the drive chamber therebetween. Shell 35 is press fitted to impeller 33 and rotates with it. Shell 35 encloses turbine 32 and separates the liquid in the drive chamber from the outside liquid in the water pump. Impeller shaft 37 is press fitted to pulley 38 which is turned by outside means not shown such as an automobile crank shaft which is connected to pulley 38 by means of elastic belt 40 or other convenient belt means. Shaft 31 is rotationally supported by race and ball bearings 42, 43. Shaft 31 has a central passage 45 which provides for excess liquid escape. Shaft 37 is rotationally supported by ball bearing races 47, 48 which are permanently lubricated by confining a lubricant therein. Vent 49 allows an escape for any fluid leakage. Seals 50 tend to prevent water from leaking out of water pump cavities.

Air or vapour or both may be introduced and removed from the drive chamber through channel 60 which communicates with tube 61 and then through slot 62 into the drive chamber. Constant contact is made between tube 61 and slot 62 through an annular space and a bore 63. Water is introduced to and removed from the drive chamber through channel 65 which is adjacent to and co-planar with channel 60. Channel 65 communicates with the drive chamber through passage 66 which leads to annular ring bore 67 which is in constant communication with four holes 68 placed in shell 35. The holes 68 are placed equidistantly about the central portion of shell 35.

Fins 70 on impeller 33 are of the standard variety and cause water which comes from intakes 71, 72 to be forced through holes 73, 74 which lead to the engine block. Turbine 32 and/or impeller 33 may be made from moulded plastics or powdered metal for economical production. The faces of turbine 32 and impeller 33 are of standard commercial variety and are designed to impart motion from one to the other.

Referring now to Figure 1 especially, the operation of an embodiment of this invention will be explained. Water is pumped through the system by means of water pump 21 and enters the schematic drawing in Figure 1 from the engine block at point 75 whence it will enter venturi tube 25 and/or radiator tube 76 depending upon the positions of thermostats 26, 27. In Figure 1 thermostat 26 is in a closed position and thermostat 27 is in an open position. The thermostats assume these positions when the engine is hot and it is desired to operate the cooling fan 23. Water enters at 75 with part of it going into venturi tube 25 and part into radiator tube 76. The part going through radiator tube 76 flows through the radiator wherein it is cooled and then flows through pipe 80 leading from radiator outlet 81, then into water pump intake 71 and is sent through cylinder block intake 73, 74 as is done in many of the cooling systems of to-day. The water flowing into venturi tube 25 is forced through tube 83 since thermostat 26 is closed and sent through connecting means 84 into channel 65 and sent into the drive chamber through the passages previously described. Water entering the drive chamber forces the air or vapour or both out through channel 60 into air tube 86 which communicates with the upper portion of radiator 22. The drive chamber becomes filled with water and impeller 33 which is attached and driven from the crank shaft of the engine imparts rotational motion to turbine 32 which turns shaft 21 and fan 23.

To empty the drive chamber of water and hence stop the rotation of fan 23, thermostat 26 is opened and thermostat 27 is closed. This is done automatically through the temperature of the engine and engine water. As the temperature reaches a predetermined level thermostats 26, 27 respectively open and close. This causes the water to flow from engine block at 75 into venturi tube 25 with none of it going into radiator tube 76 due to the closed position of thermostat 27. The high velocity of water flowing through venturi tube 25 which is multiplied by the narrowed portion causes a reduced pressure in tube 83 and connecting means 84 and water from the drive chamber is drawn through channel 65. This water along with water from the engine block flows into intake 72 and is pumped by water pump 21 through engine block intakes 73, 74 and recir-

culated. As the drive chamber is emptied of water air is drawn from radiator 22 through tube 86 and channel 60 into the drive chamber. The drive chamber being evacuated the fan ceases to rotate. A small ring of water remains about the outer circumference of shell 35 and prevents air from being drawn to the water system. Even if air were drawn into the system it would be very small in amount. However water could be kept in the outer circumference of shell 35 by adding a corrugated ring near the outer circumference of shell 35. It is seen in Figure 1 that slot 66 and the end of channel 65 are not lower than the horizontal centre line. This helps to prevent the water from being withdrawn from the central area thereby leaving some for lubrication.

Thermostat 26 may be arranged, if desired, to open before thermostat 27 is closed.

In Figure 3 is shown a schematic view of another embodiment of this invention. In this embodiment there is only one channel leading to the drive chamber, that being channel 60. There are two venturi tubes 90 on shell 35 near its outermost circumference. These venturi tubes 90 communicate with the drive chamber. Of course the number of these venturi tubes may be varied as is desirable. The shell 35 is attached to impeller 33 which is driven off the crank shaft of the engine. Thus there is a constant evacuating effect on the drive chamber when the crankshaft is rotating. Channel 60 is connected to two-way valve 92 at drive chamber coupling 93. Valve 92 is connected to the engine block water system at outlet 94. Valve 92 is also connected to the air supply of radiator 22 through radiator outlet 95. A small hole may be drilled in impeller 33 and in this embodiment the hole is .030 inches diameter. The hole is shown at 97. In this embodiment valve 92 passes air from radiator 22 into the drive chamber when the engine is cold, thus turbine 32 will be stationary. When the engine heats the valve 92 it closes the air passage from radiator 22 and opens a water passage from the engine block filling the drive chamber with water causing turbine 32 to be rotated. There is a constant evacuating effect on the drive chamber due to venturi tubes 90 and hence there is no trouble in inducing water or air to flow from the valve into the drive chamber. The cross section of the valve is shown in Figure 5. Air may pass from radiator outlet 95 into compartment 99, through opening 100 and into outlet 93 which leads to the drive chamber with the valve in the position shown in Figure 5. The valve is in this position when the engine is cool and fan rotation is not desired. As the valve warms up, stem 101 is forced from body 102 and compresses spring 103 until the stem head seats itself in opening 100 cutting off communication between outlets 95, 93. Further heating causes body 102 to move longitudinally compressing spring 105 and unseating bevelled surface 106 from opening 107 allowing water to flow from cylinder block outlet through to drive chamber outlet 93. In this position of the two-way valve water is drawn into the drive chamber causing the fan to rotate, cooling the engine. Hole 97 allows more complete filling of the drive chamber with water by allowing trapped air to escape.

This embodiment is simpler than that previously described and works more independently from the rest of the engine cooling system. When the engine is hot thermostat 110 opens allowing water from engine block to pass through T connection 111 through to radiator 22 to intake 71 of water pump 21 and then through cylinder block intake 73, 74. When thermostat 110 is closed the radiator is by-passed and the water flows directly into intake 72 and then through cylinder block intake 73, 74.

Since the opening of T connection 111 to intake 72 is more restricted than is the opening to radiator 22, when thermostat 110 is opened the water will flow into the radiator.

In the schematic drawing shown in Figure 6 still another embodiment of this invention is represented. Here channel 60 of water pump 21 is connected to thermostat 115 which in turn is connected to a portion of the cylinder block water flow. Venturi tubes 90 are placed about the outer circumference or near the outer circumference of shell 35 in as large a number as is necessary effectively to evacuate the drive chamber. Channel 60 communicates with the drive chamber as is described in the first embodiment. Thermostat 115 opens when the engine is hot and fan operation is desired. Venturi tubes 90 are connected to shell 35 which in turn is fastened to impeller 33 which is rotated by the crankshaft. There is an evacuation or withdrawing force exerted on this driving chamber when the crankshaft is revolving. Therefore upon opening of thermostat 115 water from the radiator is drawn into the drive chamber causing impeller 33 to rotate turbine 32 and hence fan 23. Upon the closing of thermostat 115 water is withdrawn from the drive chamber and due to the reduced pressure in the drive chamber vaporization and air expansion takes place to effectively fill the chamber with gas and therefore turbine 32 ceases to rotate. This embodiment is comparatively simple and operates even more independently of the rest of the automobile engine cooling system. Thermostat 110 and T connection 111 operate in conjunction with water pump and cylinder block substantially the same manner as they do for the second described embodiment.

The thermostats of the above embodiments have been described as opening or closing when the engine is hot or cold. By hot and cold is meant respectively whether the engine fan is desired to run or not to run.

There is one condition when the engine temperature is high and the fan would normally be running in the above described embodiments when it would be desirable not to have the fan in operation. This condition exists when the automobile is travelling at a relatively high speed and the air coming through the radiator grill makes the rotation of the fan unnecessary. The high speed of the water pump creates a relatively high pressure in the system and therefore a pressure-sensitive valve may be placed in various points in the system to cause the fan to stop at these high pressures. In the first embodiment in Figure 1 a pressure-sensitive valve may be placed between the venturi tube 25 and thermostat 26 or in the thermostat 26 itself. When the water pressure reaches a predetermined level the valve would open allowing water to flow through thereby causing aspirating action on tube 83 evacuating the chamber causing the fan to stop. When the water pressure decreases the valve will close causing water to return to the chamber.

In the embodiment of Figure 3 the pressure sensitive valve may be located in the passage from the valve 92 to passage 60.

In the third embodiment pictured in Figure 6 a pressure-sensitive valve may be placed between thermostat 115 and the engine block. When the water pressure reaches a predetermined level the valve will close causing the drive chamber to be evacuated stopping the rotation of the fan.

Various modifications may be made within the scope of the invention as set out in the claims.

WHAT WE CLAIM IS:—

1. A cooling system wherein a liquid is circulated by means of a coolant pump comprising a device to associate the impeller of said pump with a fan drive member in a drive chamber so that upon introduction of liquid into said drive chamber said fan will be driven by said pump impeller and upon release of said liquid from said chamber said fan will be disengaged from said impeller, temperature-controlled means to introduce liquid from the system into said drive chamber at a given engine temperature, said means being adapted to release liquid from said chamber at a given temperature, and gas supply means to fill and empty said drive chamber with a gas as the drive chamber is respectively emptied and filled with said liquid.

2. A cooling system as claimed in Claim 1 in which said temperature-controlled means comprises a venturi flow assembly, a thermostat, connecting means between the venturi in said venturi flow assembly and said drive chamber, said thermostat being located in a venturi flow stopping area whereby at a predetermined temperature said thermostat will close stopping the flow of liquid in said venturi thereby causing liquid to flow through said connecting means into the drive chamber, said thermostat being adapted to open at a further predetermined temperature whereby liquid will pass through said venturi and withdraw the liquid from the drive chamber.

3. A cooling system as claimed in Claim 1 with connecting means between said drive chamber and a liquid supply, a thermostat in liquid-stopping position in said connecting means, said thermostat being designed to open at a predetermined temperature thereby allowing liquid to flow from said supply to said drive chamber, venturi means, said venturi means being located in aspirating position to said drive chamber so that a withdrawing force is exerted on said drive chamber, said withdrawing force being of sufficient strength to withdraw liquid from said drive chamber even when said thermostat is in a flow-stopping position, thereby reducing the pressure in said chamber so that said chamber may be effectively evacuated of liquid.

4. A cooling system as claimed in Claim 1 with connecting means between said drive chamber and an air supply and a liquid supply, a thermostatically controlled valve, said valve being set at a predetermined temperature to select one of the connecting means from said drive chamber to said air supply and to said liquid supply in preference to the other, said valve being located in a selective position, venturi means, said venturi means located in a liquid-withdrawing position from said drive chamber, said venturi means exerting a withdrawing force on said chamber thereby exerting a withdrawing force on said connecting means.

5. A cooling system as claimed in Claim 4 with said selective valve comprising three portions one of said portions leading to a liquid supply, one of said portions leading to said drive chamber, one of said portions leading to said air supply, there being thermostatic means extending through all three portions, said thermostatic means being designed to connect said drive chamber portion with one or other of the other portions according to the temperature

6. A cooling system as claimed in Claim 1 with connecting means between said drive chamber and a liquid supply, a thermostat in liquid-stopping position in said connecting means, said thermostat being designed to open at a predetermined temperature thereby allowing liquid to flow from said supply to said drive chamber, drive chamber evacuating means designed to utilize pressure differentials in said drive chamber so that an evacuating force is imposed upon said drive chamber, said evacuating force being of sufficient strength to withdraw liquid from said drive chamber even when said thermostat is in a flow-stopping position thereby vaporizing the liquid in said chamber and expanding the air in said

chamber so that said chamber may be effectively evacuated of said liquid.

7. A cooling system as claimed in Claim 1 with said temperature-controlled means being also adapted to empty said drive chamber of liquid when the coolant velocity reaches a predetermined level.

8. An automobile engine cooling system wherein there are passages in the automobile engine for coolant to flow, where there is a coolant pump, a radiator, a radiator pipe connecting said engine passages and radiator, a radiator by-pass connecting said passages and said coolant pump, a radiator thermostat which at a predetermined temperature will close the pipe between said radiator and engine and direct coolant from said engine passages through the coolant pump back to the engine passages, comprising a driven member, an impeller, said impeller being driven by said engine, a chamber containing said member and impeller, means for connecting said member with an engine fan designed to circulate air about said engine, said member being coaxial with and axially spaced from said impeller, the facing surfaces of said impeller and said member being designed so that upon introduction of fluid between said surfaces rotational force will be transmitted from said impeller face to said member face, a venturi, said venturi being located in said radiator by-pass, an aspirator tube, said tube connecting said venturi and said chamber, a by-pass thermostat, said thermostat being located between said venturi and said coolant pump, a chamber outlet pipe, said outlet pipe connecting said chamber with an upper portion of said radiator above the water level in said radiator.

9. The cooling system of Claim 8 with pressure sensitive means in combination with said by-pass thermostat whereby upon a predetermined water pressure said thermostat will open even though the engine temperature is above the thermostat closing temperature due to the high velocity of engine coolant impinging upon said means.

10. A motor vehicle engine comprising a cooling system as claimed in any of Claims 1 to 7.

11. A motor vehicle engine cooling system substantially as described with reference to Figures 1 and 2 of the accompanying drawings.

12. A motor vehicle engine cooling system substantially as described with reference to Figures 3, 4 and 5 of the accompanying drawings.

13. A motor vehicle engine cooling system substantially as described with reference to Figures 6 and 7 of the accompanying drawings.

MARKS & CLERK.

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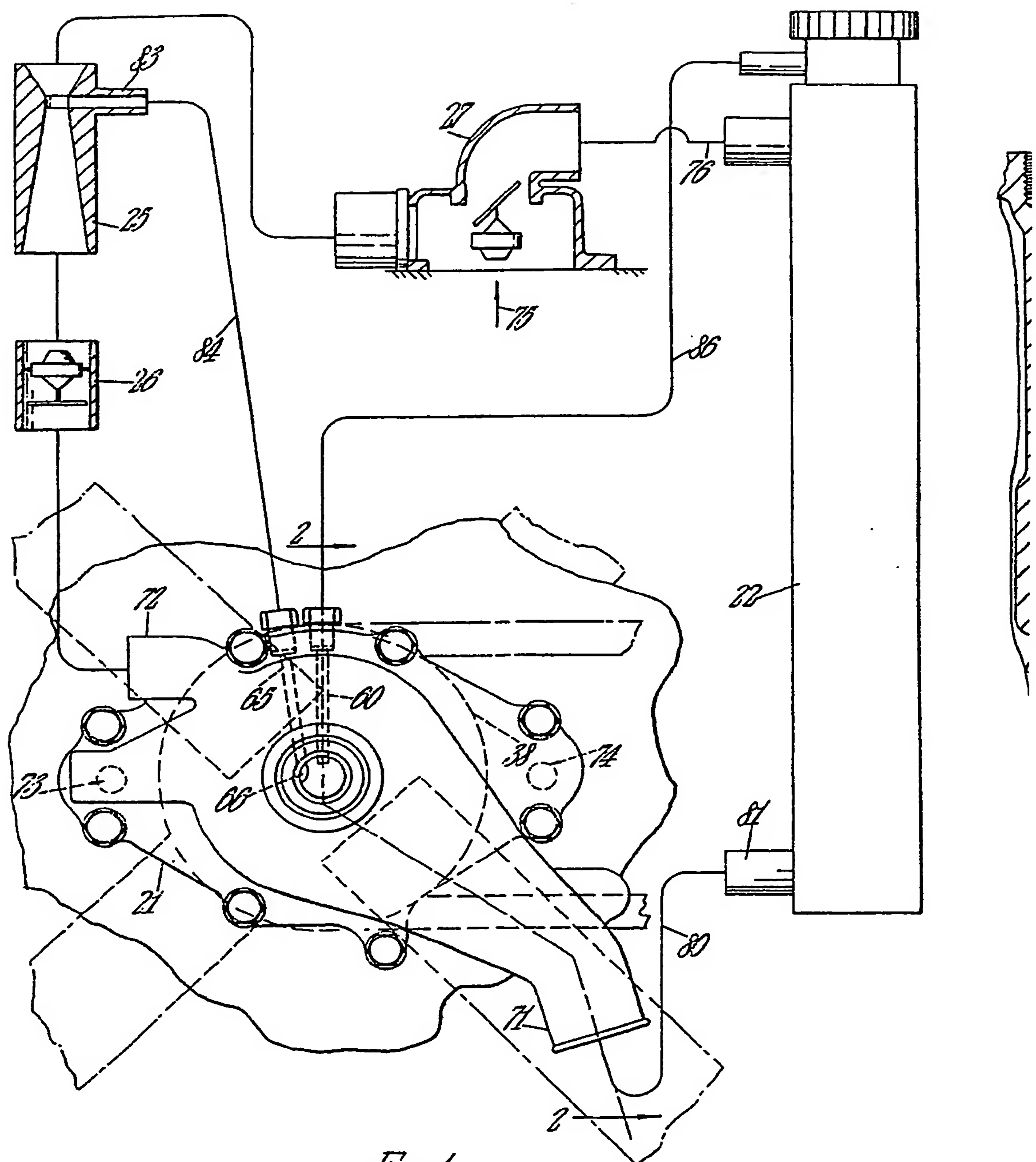

Fig.1.

824,783 COMPLETE SPECIFICATION
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SHEETS 1 & 2

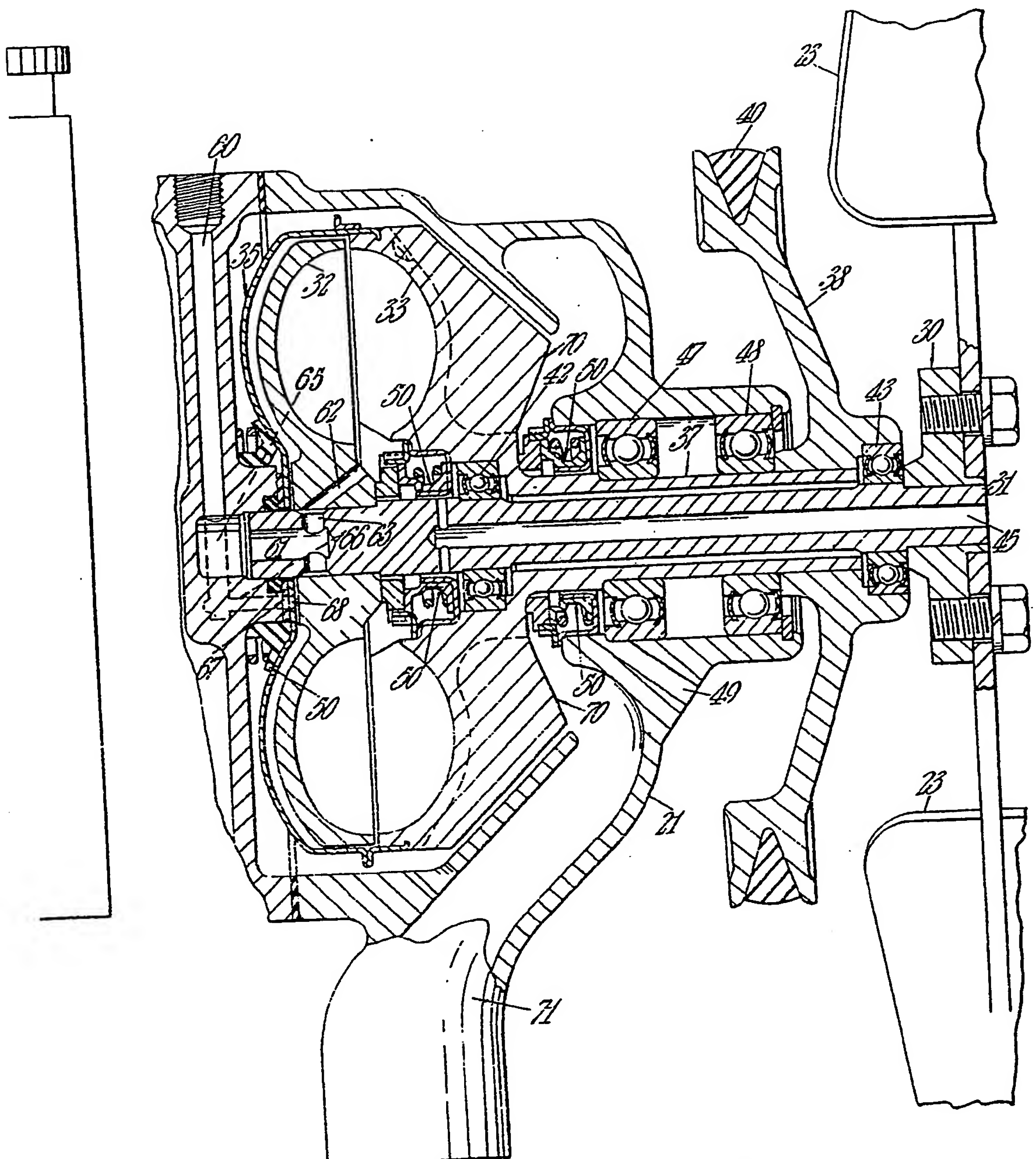

Fig. 2.

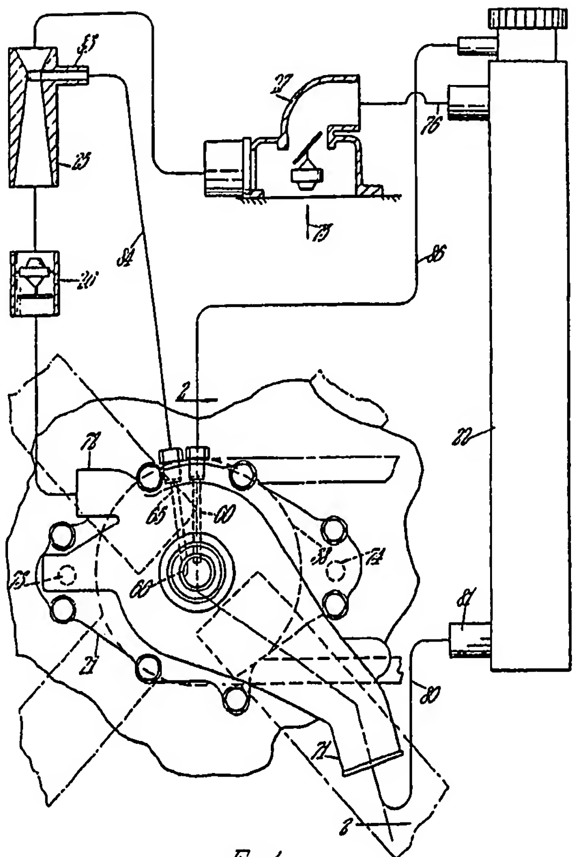

Fig.1.

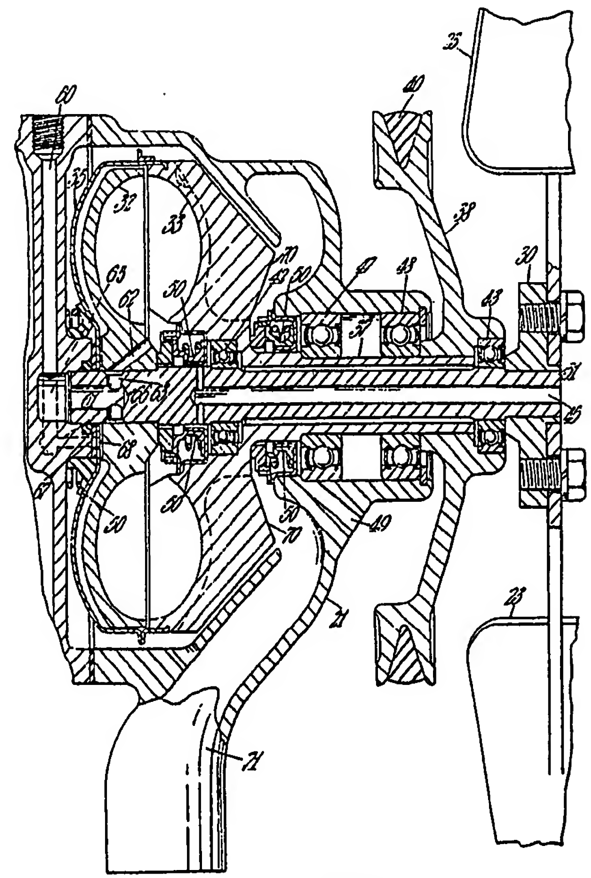

Fig. 2.

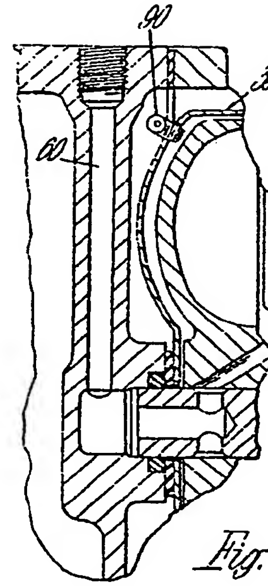

Fig. 4.

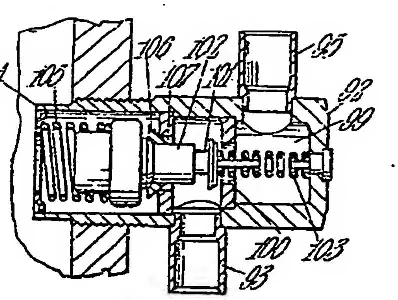

Fig. 5.

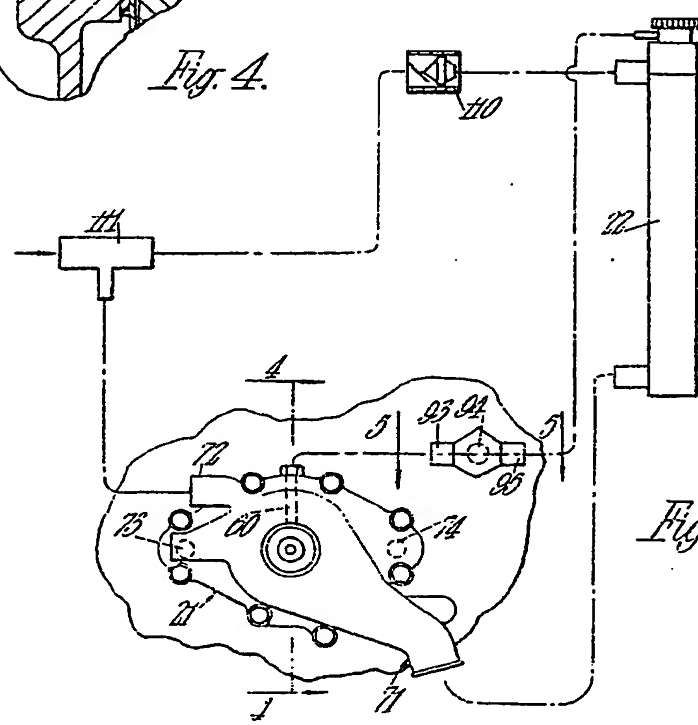

Fig. 3.

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SHEETS 3 & 4

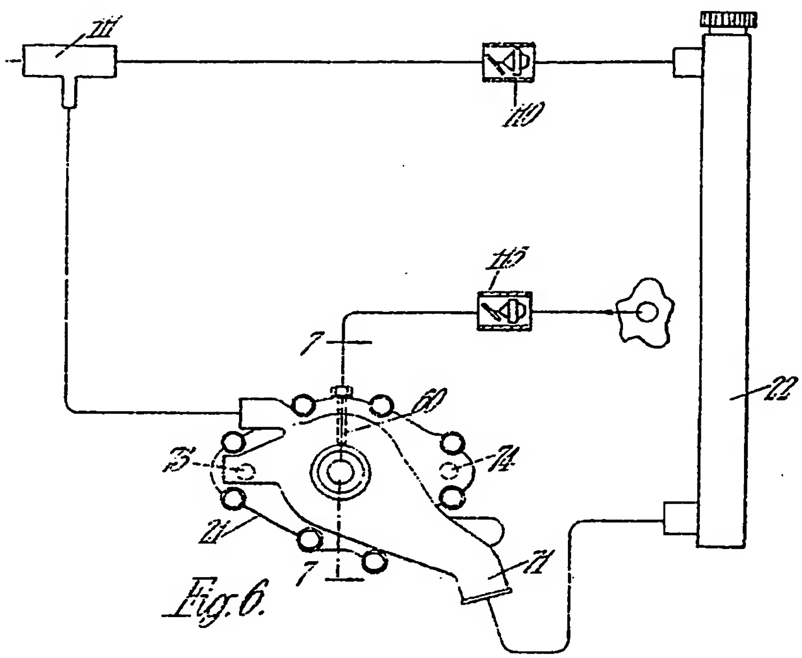

Fig.6.

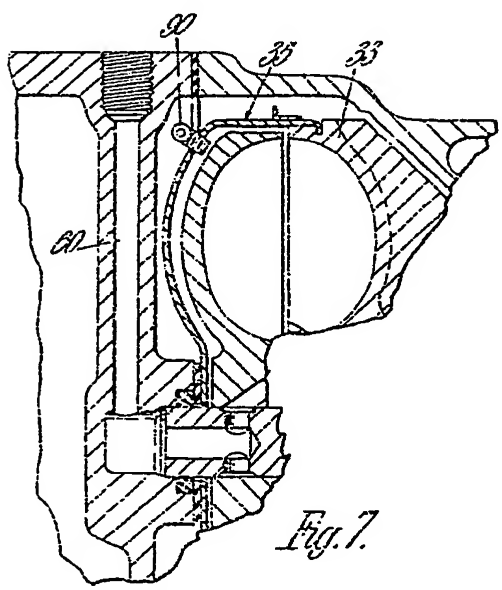

Fig.7.

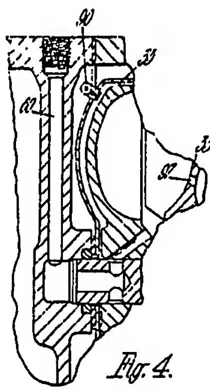

Fig. 4.

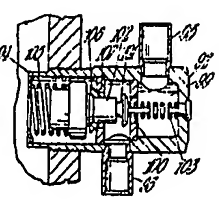

Fig. 3.

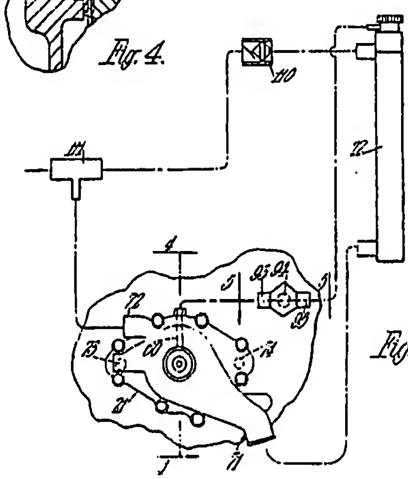

Fig. 5.

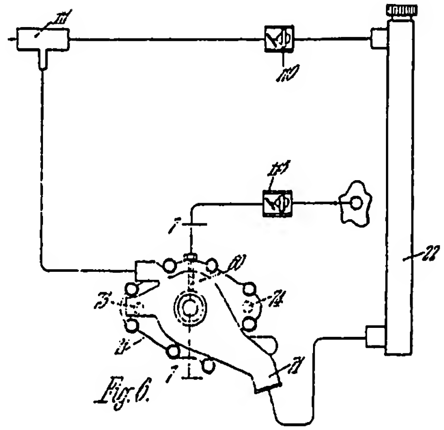

Fig. 6.

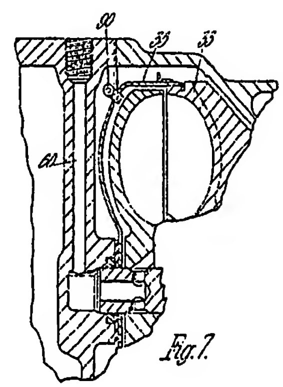

Fig. 7.

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